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THE ECONOMICS OF HOSPITAL AUTOMATION

by

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BACHELOR OF SCIENCE IN  
BUSINESS ADMINISTRATION  
1960  
Long Island University, New York

A thesis submitted to the faculty of the School  
of Government, Business and International Affairs  
of The George Washington University in partial  
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of Master of Business Administration.

June 6, 1962

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## CHAPTER I

### INTRODUCTION

#### The Inflationary Spiral in Hospital Costs

In the years since the end of World War II and the relaxing of price and wage controls there has been a marked rise in hospital costs far beyond the normal rise explained by the shrinking of the dollar. Hospital costs are high. They have increased since World War II at an average rate of about one percent per month. During the same period the Consumer Price Index has remained relatively stable, with an increase in all items at an average rate of less than one-half percent per year.<sup>1</sup>

The Bureau of Labor Statistics of the United States Department of Labor has reported that from 1937 to 1959, the latest year for which detailed, reliable hospital cost statistics are currently available, the cost of hospital care rose 346.3 percent, as contrasted with a general increase for all consumer items of 110.8 percent.<sup>2</sup> From 1937 to 1959 actual dollar expenditures for professional hospital services increased by more than 700 percent; expenditures for non-professional services increased by 275 percent. Narrowing the span to the twelve-year period between 1947 and 1959, we find that dollar expenditures for professional services increased by 200 percent as compared with an increase of

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<sup>1</sup>Henry N. Pratt, "The High Cost of Hospital Care is Going Higher," Hospitals, Journal of the American Hospital Association, Vol. 32 (June 1, 1958), 41-43, 96.

<sup>2</sup>U. S. Department of Health, Education and Welfare, Health, Education and Welfare Trends, 1961 (Washington: U. S. Government Printing Office, 1961), pp. 22-23, 61.



100 percent for non-professional services.

Professional services twenty-two years ago accounted for approximately one-third of the hospital's expenditures. Now almost two-thirds of the hospital's over-all budget is used in defraying these costs. These services include expenditures for nursing service, pharmacy and medical supplies, medical records, operating and delivery rooms, as well as a large number of diagnostic and therapeutic departments, such as x-ray, laboratories, physical therapy, radiotherapy and electrocardiography.

The amounts spent for nutrition services increased 90 percent from 1937 to 1959; the cost of drugs and medical supplies increased 650 percent. For the same period expenditures for housekeeping, laundry and maintenance services increased by 150 percent, and for x-ray and laboratory services by 520 percent. There was a 390 percent increase in administrative and general service costs.

The two measurements most frequently used to evaluate hospital operations are cost per patient-day and cost per patient-stay. From 1937 to 1945 hospital costs per patient-day increased 25 percent. The annual increase in patient-day costs over this period averaged \$1.64. The average patient-day costs during the post-war era, from 1947 to 1959, increased from \$15.50 to \$32. This is an increase of 106 percent. Over this same period, the cost per patient treated increased from \$163 to \$307--an increase of 88 percent.

Based on the assumption that hospital costs will continue to rise in the same proportion as between the years 1947 and 1959, over-all average patient-day costs in 1970 should approximate \$48 per day, with individual hospital costs ranging from \$30 to more than \$60 per day. This projection indicates that over a span of eleven years, from 1959 to 1970, patient-day costs will have increased 50 percent. Actually, such a projection will be realized if the percentage



increase in patient-day costs averages no more than 4 percent per year.<sup>3</sup>

This estimate, however, is considered by many authorities in the hospital field to be much too conservative. Unless there is a very significant change in the general economic situation, it is expected that an annual increase in hospital costs of from 5 to 10 percent will continue for many years, and only by the best efforts of the hospital staffs can increased costs be held at that level.<sup>4</sup>

#### The Impact of Advances in Scientific Medicine

The increase in hospital costs has many facets. Of these, the most consequential have been advances in medical science and the resulting demand for more skilled personnel and for expensive new equipment.<sup>5</sup> Refinements and advances in the medical sciences began in the late thirties and accelerated greatly after World War II. Among these advances are:

(1) Increasing reliance on laboratory techniques in diagnosis and as a guide to therapy.

(2) Increasing complexity of x-ray diagnosis.

(3) More extensive use of high voltage radiation in cancer therapy.

(4) Broadening field of surgical treatment as exemplified by rapid advances in heart and lung surgery.<sup>6</sup> Today's specialized and intricate surgical procedures require many more special-purpose surgical instrument trays and

<sup>3</sup>Charles G. Roswell, "Hospital Costs . . . Yesterday, Today and Tomorrow," Hospitals, Journal of the American Hospital Association, Vol. 35, (June 16, 1961), 42-43.

<sup>4</sup>Ray E. Brown, "The Nature of Hospital Costs," Hospitals, Journal of the American Hospital Association, Vol. 30 (April 1, 1956).

<sup>5</sup>George Bugbee, "Hospitals In The Public Eye," Hospitals, Journal of the American Hospital Association, Vol. 34 (January 1, 1960), 54-56.

<sup>6</sup>Pratt, Hospitals, Journal of the American Hospital Association, Vol. 32, 41.



dressing kits than were needed twenty years ago. A phlebotomy tray, for example, which is used when cutting through the skin to reach a vein, contains up to sixty different items, including twenty instruments, costing approximately \$150.

(5) Extensive use of new and expensive drugs, especially in the conquest of infection.<sup>7</sup> Many of the drugs which hospitals must stock and have available for instant use were unheard of twenty years ago. The chemical usefulness of penicillin and sulfa-drugs, for example, was not recognized until about 1938. Some other so-called "miracle" drugs were discovered during the middle and late forties.<sup>8</sup>

(6) Development and use of new scientific approaches to the solution of medical problems, such as radioisotopes and the artificial kidney.

These are but a few of the developments to improve health services made possible by medical research.<sup>9</sup> Both the medical profession and the American public demand that every discovery and improved procedure be made immediately available within the hospital. As medical science progresses, there is no alternative but for hospitals to keep pace by providing the necessary facilities. Every medical advance, however, can be measured in terms of added hospital costs and added hospital personnel. The scientific revolution, in other words, has enabled us to do much more, but it has required far greater expenditure.<sup>10</sup>

#### The High Cost of Labor

There are three additional principal factors contributing to high hospital costs. These factors all relate to labor. The portion of the hospital dollar spent on salaries and wages has been slowly but steadily increasing.

<sup>7</sup>Ibid.

<sup>8</sup>Roswell, Hospitals, Journal of the American Hospital Association, Vol. 35, 42-48.

<sup>9</sup>Pratt, Hospitals, Journal of the American Hospital Association, Vol. 32, 41.

<sup>10</sup>Brown, Hospitals, Journal of the American Hospital Association, Vol. 30.



Viewing the effect of this trend on patient-day costs, we find that in 1947, when such costs averaged \$15.50 a day, salaries and wages accounted for \$9, or 58 percent, of the total. In 1959, salaries and wages accounted for \$21, or 65.6 percent, of the reported \$32 patient-day cost. The rather substantial increase in payroll expenditures since 1947 may be attributed to a number of factors, but notably to the national trend toward higher wages, fewer hours of work, and a requirement for greater competency as a result of the accelerating pace of technological advancement.<sup>11</sup>

The upward spiral of wages and salaries - Because of the phenomenon of increased production per man-hour in industry, made possible through constant improvements in methods and machines, industry has been able to grant sharp wage increases without proportionately increasing production costs. The nature of the hospital's work provides little opportunity for such gains. The fundamental nature of hospital care is personal service. It must be performed primarily by people. Industry is able to cut costs by getting greater production per employee through automation. This has been possible to a very limited extent in hospitals. Much of the work of the hospital requires the presence of individuals and the utilization of judgement. The opportunities for the alternative use of machines when labor costs exceed the cost of the machines have not been too abundant in the hospital field. Nevertheless, hospital labor costs are affected directly by general salary levels, and every round of salary increases constitutes a direct increase in hospital costs.

With high employment opportunities, hospitals have been forced to continue increasing wages and salaries in order to maintain working complements in the face of severe competition. Even so, most hospital jobs are still

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<sup>11</sup>Roswell, Hospitals, Journal of the American Hospital Association, Vol. 35, 42-48.



priced below the going rates for comparable employment in industry and do not generally provide for comparable benefits. It is all too obvious that in the competition for personnel in a period of high employment, hospital wages and salaries must be increased in proportion to those in industry. In the years ahead, as the general labor force continues to participate in the proceeds from increased production, hospitals will be compelled to give equal salary increases without comparable benefits in production.<sup>12</sup>

The shorter work week - With the increased production per man-hour in industry, the work week has been steadily decreasing. For a hospital, however, there can be no off-hours. It operates on a twenty-four hour day, seven-day week. This must be so if a hospital is to render adequate patient care and necessary stand-by service. But since hospitals must compete with industry in the recruitment of workers of all kinds, they too have reduced the standard hours of work. Progress has been slow, but steady, in the adjustment of hours and the betterment of working conditions. Prior to World War II, the average hospital employee worked a fifty-four hour week. Since the end of World War II, however, due to the big push by hospitals to compete for personnel on an equal basis with industry, there has been a trend toward a forty-hour work week. This has resulted in a marked rise in per diem costs as additional employees were hired to make up the difference.<sup>13</sup> In 1947, for example, the number of employees per patient averaged 2.1, whereas in 1959 the average was 2.8.<sup>14</sup>

Shifts in proportion of skilled to unskilled employees - Advances in medical science create new demands for technical and professional competency.

<sup>12</sup> Brown, Hospitals, Journal of the American Hospital Association, Vol. 30.

<sup>13</sup> Pratt, Hospitals, Journal of the American Hospital Association, Vol. 32, 41-43, 96.

<sup>14</sup> Roswell, Hospitals, Journal of the American Hospital Association, Vol. 35, 42-48.



The provision of new services and new procedures which permit the physician to diagnose and treat more varied and more complex conditions has increased the proportion of skilled to unskilled employees and thereby increased the total payroll. Approximately one out of every three hospital employees meets the definition of a skilled employee.<sup>15</sup>

Nursing care, in particular, has commanded a larger share of the hospital cost dollar. The rapid increase in nursing responsibilities, made necessary by advancing medical technology, has required hospitals to employ more and better prepared nurses. With a long history of inadequate salaries and with increasing employment opportunities for the limited supply of nurses, hospitals have had no alternative but to increase nursing salaries at frequent intervals.<sup>16</sup>

The problem of adequate qualified personnel, and the cost of personnel for hospitals is compounded because of increasing professionalization and legal licensure of most skilled employees. Even though the hospital is the major user, and in some instances the only user, of certain skills, the hospital has less and less to say about required qualifications and training. More and more, standards are being set by national organizations representing the various technical and professional groups. The desire on the part of most organizations to develop status for their members causes them to work toward upgrading the individual as a person as well as a worker.

The social necessity for professionalization and legal control of a large segment of the hospital's personnel structure is well recognized; however, inevitably, extraneous standards are imposed which serve as an inhibiting

<sup>15</sup> Brown, Hospitals, Journal of the American Hospital Association, Vol. 30.

<sup>16</sup> Pratt, Hospitals, Journal of the American Hospital Association, Vol. 32, 41-43, 96.



influence in that they decrease the number eligible and increase both the length and cost of preparation for employment. These elements must be recognized in the salary offered after entry on the job if the particular career is to compete successfully with alternative careers. Therefore, the tendency of professional organizations to insist on lengthening the period of pre-professional training represents additional burden to hospital costs.<sup>17</sup>

**The Administrator's Dilemma:  
Containing Hospital Costs**

The factors responsible for the probability that hospital costs will continue to increase by 5 to 10 percent per year for years to come are, for the most part, beyond the direct control of the hospital administrator. Even with the best efforts on the part of all concerned, hospital care is inevitably becoming increasingly expensive. Hospitals still are acutely pressed for space, for new and expensive equipment, and for the services which come with new advances in medical knowledge and better standards of medical care. The necessity to fulfill these needs portends a continuing and large increase in this portion of the hospital expense dollar.<sup>18</sup>

The public accepts nothing less than the ultimate: that every patient be given the best possible care. Individuals, as patients or as relatives, demand every service which will extend life, reduce pain and suffering, or mitigate the inevitable worry associated with illness.<sup>19</sup> One may question, however, whether these new services are being made available in sufficient

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<sup>17</sup> Brown, Hospitals, Journal of the American Hospital Association, Vol. 30

<sup>18</sup> Pratt, Hospitals, Journal of the American Hospital Association, Vol. 32, 41-43, 96.

<sup>19</sup> Bugbee, Hospitals, Journal of the American Hospital Association, Vol. 34, 54-56.



quantity and quality to meet increasing demands. There is generally a great time lag between the development of new and proven medical advances and their introduction into hospital practice. This lag is due, in part, at least, to the concern of responsible administrators for finding the means to finance these new services.

The vital and troublesome problems of containing hospital costs and still improving the quality of service are receiving the very serious attention of hospital administrators everywhere. It is inevitable that the upward spiral of industrial wages, the shortening of the work week, the necessity to pay adequate wages to hospital employees, and the need to provide patients with the benefits of rapidly accelerating advances in medical technology will result in a continuing increase in hospital costs. Thoughtful persons in the hospital field have begun to explore all possible means for achieving greater economies and defeating the inflationary spiral.<sup>20</sup> With the hospital budget currently consisting of more than 65 percent labor, administrators are convinced that ways must be found to make hospital employees collectively more productive. Talk of automation and labor-saving devices is becoming more prevalent in hospital circles and is appearing with increasing frequency in hospital literature.

Although hospitals, because of the personal nature of their services, have found it difficult to adopt assembly-line techniques, they have found that certain areas and functions lend themselves quite naturally to automation, particularly the food-service, central supply, and laundry departments. More of the routine functions of carrying on the business activities are being handed over to machines, and more and more research is being conducted in which the principal objective is the determination of those hospital activities in which some form of automation is practical and more economical. The remainder of

<sup>20</sup>Pratt, Hospitals, Journal of the American Hospital Association, Vol. 32, 41-43, 96.



this paper is a review of current progress in this endeavor.



## CHAPTER II

### THE TREND TOWARDS AUTOMATION IN HOSPITAL OPERATIONS

#### Current Progress in Mechanization

The trend in business and industry over the years has been to increase production per man-hour through greater utilization of machines and other labor saving devices. In the hospital field the trend has been toward an increasing ratio of employees per patient and an increasing portion of the hospital expense dollar being utilized for payrolls. In an effort to reverse this trend in hospitals, responsible individuals have begun to demonstrate their ability to adopt, for use in non-medical activities, the labor-saving devices and procedures that have long been used with telling effect in business and industry. Progress is also being made in utilizing mechanized procedures in activities directly related to professional patient care.

Administrative services.--The diverse activities classified as "administrative services" are an important part of the hospital expense dollar and are growing more rapidly than other items in the hospital budget. Approximately 10 percent of all salary expenses appear to be in this department. Because few of the activities of this category are unique to hospitals - for example, accounting, payroll, personnel, purchasing and related activities - labor-saving devices and procedures from non-hospital industries have been readily adapted.<sup>1</sup>

<sup>1</sup>Mark S. Blumberg, "Hospital Automation: The Needs and the Prospects," Hospitals, Journal of the American Hospital Association, Vol. 35 (August 1, 1961), 34-43, 99.



Good progress has been made in the use of electronic accounting procedures, and several types of automatic typewriters and accompanying equipment have been in use in some hospitals for several years. Automatic typewriters are reported to accomplish, more efficiently and in a fraction of the time required by conventional methods, many of the clerical routines characteristic of administrative services. Although no comparative cost data are currently available, the replacement of costly labor with automatic typewriters is estimated, in the long run, to be far more economical, particularly in view of the trend towards increasing volumes of paperwork. For example, these typewriters are installed in a central office where special repetitive letters and other materials are automatically typed from punch-tapes which are prepared in such a way that personalized information can be inserted where necessary to avoid a form-letter appearance. Letters prepared in this fashion are expertly typed, and without error. This type of equipment is also being used to prepare payrolls and payroll checks, purchase orders and requisitions, and to perform many other repetitive services which, by conventional methods, require long tedious hours.<sup>2</sup>

Food preparation and service.--Although food service represents about 14 percent of the hospital cost dollar, a relatively insignificant portion of the over-all increase in hospital operating costs can be attributed to this department. That food service expenses have remained relatively stable during the period of inflation is attributed to the fact that this department, more than any other, has made use of more and more automatic equipment and labor-saving devices. Such items as automatic timers on mixers, steamers, and dish-washing machines; automatic dispensers and automatic coffee makers; and electric food preparation equipment have been made available to this department to aid

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<sup>2</sup>Lawson A. Morgan, "What's Ahead In Hospital Equipment," Hospitals, Journal of the American Hospital Association, Vol. 33 (May 16, 1959), 83-94.



in overcoming the high-cost-of-labor problem for many years.<sup>3</sup> Manual lifting and carrying has practically been eliminated throughout the food service department, from the point of delivery of bulk food to the serving line. Much greater use is being made of lightweight electric, manual and hydrolically operated jacklifts on wheels for transporting food preparation equipment; electric hoists on light overhead tracks are being used to transport bulk food from the preparation area to the cooking and serving area; and for repetitive type procedures, such as the preparation of trays for decentralized food service, increasing use is being made of conveyor belts. In hospitals where conveyor belt systems are being used, labor requirements are reduced and the serving of trays expedited.<sup>4</sup>

Laundry operations.--Laundry expenses typically account for approximately 3 percent of the hospital cost dollar<sup>5</sup>, yet with almost two-thirds of this expense being labor costs, this portion of the hospital budget is being further reduced by utilizing more efficient, labor-saving equipment, such as the combination washer-extractor. Despite the long established popularity of the automatic washer-extractor for home use, institutional laundries have had to wait a long time for this type of machine. The combination machines have been found to have many cost saving advantages which make them particularly desirable for hospital laundries: they cost less to buy than the conventional washer and separate extractor; they require less floor space, therefore, where additional capacity is needed, replacing existing washers and extractors with these machines may make expansion of existing facilities unnecessary; being

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<sup>3</sup> Blumberg, Hospitals, Journal of the American Hospital Association, Vol. 35, 34-43, 99.

<sup>4</sup> Elizabeth C. Downes, Owen Weber, and Arthur C. Avery, "Three Looks At Hospital Food Service In The Sixties," Hospitals, Journal of the American Hospital Association, Vol. 34 (January 1, 1960), 66-75.

<sup>5</sup> Kansas City Area Hospital Association, Report of the Hospital Cost Study Committee, (Kansas City: Kansas City Area Hospital Association, 1959), p. 38.



sealed machines, they may be located anywhere that a proper foundation, power, water and waste facilities can be provided; and finally, because wet laundry does not have to be transferred from one machine to another, no hoists and monorails are needed, and fewer trucks and baskets are required. Considerable savings in labor, time, water and supplies are being realized at institutions where the combination washer-extractor has been installed. The percentage of labor saving depends on the size of the machine and the type of control; however, it is estimated that the washroom payroll can be reduced 50 to 60 percent because several handlings during a washing operation are eliminated by the automatic process.<sup>6</sup>

Laboratory procedures.--Laboratory expenses amount to approximately 7 percent of the over-all cost of hospital operations,<sup>7</sup> but perhaps more significant is the fact that the laboratory is one of the fastest growing departments in the hospital. The rapid growth in the volume of laboratory services, together with a shortage of laboratory technicians, has pointed up the critical need for an increasing number of labor-saving devices in this area.<sup>8</sup> There is practically no limit to the rate at which laboratory services might grow. Formerly, the number of tests that could be ordered was actually limited by the amount of blood that could safely be drawn from the patient, but with modern micro-techniques, this limitation has been removed. The laboratory, because it is more closely allied with medical research than any other hospital department, has been one of the first to enjoy the benefits of automation and related labor-

<sup>6</sup>George Juppe, "Combination Washer-Extractor Makes the Most of Time and Space," Hospitals, Journal of the American Hospital Association, Vol. 34, (September 16, 1960), 130-34,159.

<sup>7</sup>Kansas City Area Hospital Association, Report of the Hospital Patient Cost Study Committee, 1959, p. 38.

<sup>8</sup>Mark S. Blumberg, "Men, Machines, and Hospitals," Hospital Progress, (November, 1959), 75.



saving devices. In recent years, there have been substantial increases in the number of such devices available. Perhaps better known is an automatic device for making red blood cell determinations, which is also being adapted for white blood cell counts. Many hospitals throughout the country have purchased this device, which is not only labor-saving, but also greatly increases accuracy. There is also a new device commercially available for the blood cell counter that does the pipetting accurately and automatically.<sup>9</sup> In the rapidly growing field of blood chemistry, machines and electronic devices are being used to perform certain chemical analyses, including original pipetting of the material, formerly accomplished by skilled technicians. Special equipment has also been devised to assist in various other laboratory tests. With the aid of such devices, a single technician is able to do the work of several, with more accuracy and precision.<sup>10</sup>

Nursing services.--The nursing service is by far the largest single department with respect to expenses. It is estimated that nursing wages alone typically amount to approximately 27 percent of the hospital's expense dollar.<sup>11</sup> The growth in this area has not been as rapid as in some others, yet there has been a 50 percent increase in nursing service expenses since 1952.<sup>12</sup> Although opportunities for mechanization in the area of personal service to the patient have been limited, several improvements have been introduced which have helped

<sup>9</sup> Blumberg, "Hospital Automation: The Needs and The Prospects," Hospitals, Journal of the American Hospital Association, Vol. 35, 34-43, 99.

<sup>10</sup> H. G. Higgins, "Ten-Point Program for Lowering Costs," Hospitals, Journal of the American Hospital Association, Vol. 35 (March 16, 1961), 45-47, 110.

<sup>11</sup> Kansas City Area Hospital Association, Report of the Hospital Patient Cost Study Committee, 1959, p. 38.

<sup>12</sup> Blumberg, "Hospital Automation: The Needs and the Prospects," Hospitals, Journal of the American Hospital Association, Vol. 35, 34-43, 99.



to reduce expensive nursing service time. One example is the electrical bedside control center, which, in its present stage of development, is a completely integrated self-help patient care facility. This device allows the patient to control room temperature, lights, bed height and position, draperies, radio and television, as well as a new type of automatic telephone, directly from his bed.<sup>13</sup> Another improvement that is reported to result in significant savings in nursing service time is the replacement of nurses call systems which make use of buzzer and lights with complete voice intercommunication systems similar to those which have long been a permanent part of the modern businessman's office. Surveys conducted at hospitals where the new call system is being used reveal that from 44 to 49 percent of all trips which resulted with the buzzer and light are saved with the complete voice intercommunication system.<sup>14</sup>

Another area of labor-saving devices which has developed primarily as a result of the need for conserving nursing service time is that of prepackaged and throw-away goods. Disposable hypodermic syringes and needles, surgeons' gloves, intravenous feeding systems, catheters, and patient examination gowns are just a few of the completely disposable supply items currently available.<sup>15</sup> Because this is a growing field which is beginning to have an impact, not only in the nursing service, but throughout the hospital, it will subsequently be given separate consideration.

<sup>13</sup>"Labor-Saving Techniques and Devices Highlight the Hospital Merchandise Mart," Hospitals, Journal of the American Hospital Association, Vol. 32 (July 16, 1958), 71-74.

<sup>14</sup>John D. Thompson, John F. O'Connor and Hugh J. Maher, "Who Really Uses The Nurse-Patient Communication System," Hospitals, Journal of the American Hospital Association, Vol. 33 (February 1, 1959), 40-44, 92.

<sup>15</sup>"Labor-Saving Techniques and Devices Highlight the Hospital Merchandise Mart," Hospitals, Journal of the American Hospital Association, Vol. 32, 71-74.



**Potential Hospital Application of Recent Advances  
in Electronic Systems**

As the payroll is the largest single item in the hospital budget and most of the labor in the hospital is used in activities involving patients, more automatic devices at the patient's bedside, particularly in instances where a constant vigil is required, is a potential solution to the problem of constantly mounting hospital costs. This is an area where electronic devices are expected to play a major role in the future. Such devices have already proved their worth in industry, and their potential for utilization in the hospital has been well demonstrated in America's man-in-space program.<sup>16</sup>

Among the new developments which have resulted from efforts of space medics to observe and record activities and physiological characteristics of animals or humans in space vehicles are electronic systems that will enable a nurse to monitor the conditions of many patients from a central post. These systems utilize miniaturized measuring instruments which can be easily attached to the patient. The basic element in these instruments is a transducer, an electrical microphone frequently no larger than a dime, which translates sounds, temperatures and other bodily phenomena into electrical signals. These signals can be relayed, with or without wires, to an area where they can be amplified, recorded on oscilloscopes and/or observed. The information can be automatically analyzed and when, according to prearranged standards, danger signals appear, a warning device may be activated to alert the attendant.<sup>17</sup>

A variety of information from patients can be monitored in this fashion. Some of the variables include blood pressure, skin temperature, body temperature, pulse rate, respiration, electrocardiogram, electroencephalogram, heart sounds

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<sup>16</sup> Morgan, Hospitals, Journal of the American Hospital Association, Vol. 33, 83-94.

<sup>17</sup> Jene Bylinsky, "Electronic Aids Help Doctors Diagnose Ills, Ease Nurses' Task," Wall Street Journal June 26, 1961, p. 1.



and blood oxygen content. Such equipment will probably play its greatest role in the monitoring of critically ill patients, or those particularly susceptible to sudden changes in condition. Thus, there will probably be specially designed equipment of this type for use in the operating room, the recovery room, the obstetrical suite, the premature nursery, and possibly the newborn nursery. The tendency toward the concentration of critically ill patients in intensive care units, and the routine concentration of patients in the above mentioned areas will facilitate the introduction of such devices. It is likely that routine physiological observations, such as temperature, pulse and respirations, will be made on patients throughout the hospital by such systems in the near future.

It is not certain what these monitoring systems, which are at present quite expensive, ranging from hundreds to thousands of dollars, will do in the way of affecting costs in hospitals. It is certain, however, that they will reduce staff needs considerably. By flicking a switch, for example, one nurse can take the temperatures of all patients in a few minutes, compared with an hour or more that would be required to make the rounds of all beds with a thermometer. Such systems will, no doubt, be constantly improved in years to come, and they will be made available in greater quantity and at lower prices.<sup>18</sup>

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<sup>18</sup> Blumberg, "Hospital Automation: The Needs and the Prospects," Hospitals, Journal of the American Hospital Association, Vol. 35, 34-43, 99.



## CHAPTER III

### THE GROWTH OF PREFPACKAGED AND DISPOSABLE PRODUCTS

#### Things Versus People

Fantastically increased labor costs have been required to change traditional attitudes, but today more and more hospital administrators are becoming aware that they can use fewer people by using more things; expensive time is sacrificed in saving supplies. A great deal of mental adjustment has been required for this change in attitude. When operating costs are excessive, the normal human tendency is to save. However, administrators are finding that saving supplies sometimes costs more than throwing them away. The higher wages have soared, the more things have become cheaper than people. As people are by far the most costly hospital supply item, there is a growing emphasis on economy of labor in all possible areas. The result is a big breakthrough in prepackaged and disposable products.<sup>1</sup>

The use of disposable and prepackaged supplies in hospitals has been increasing for about ten years, particularly in the last five or six years.<sup>2</sup> The obvious reason that increasing numbers of such items are being adopted is that they reduce personnel hours without compromising medical standards, and as the workload on groups of employees is reduced, payroll savings are ultimately

<sup>1</sup> Harry K. DeWitt, "Disposables: Hospitals Find 'Things Cheaper Than People,'" Hospital Topics (October, 1957).

<sup>2</sup> "Changing Standards, Controls and Responsibility for Sterility and Materials of Disposable Medical Supplies," Conference, Publication of the Science Information Bureau, Vol. 2, No. 3 (May 1961), 1.



obtained.

### Extent of the Market

The patient who enters a modern hospital receives the benefit of superior diagnostic services, new types of surgery, more effective drugs, and new and more elaborate equipment. These modern improvements have resulted in vast changes in the operation of hospitals, requiring increased numbers of skilled and semiskilled employees. Recognizing that increased labor costs have contributed significantly to the inflationary spiral in the cost of operations, manufacturers have come to the aid of hospitals by providing a vast array of labor-saving products, particularly in areas of professional patient care and hospital food service.

Products for professional care.--In the professional care area, suitable disposable equivalents have been provided for almost anything that has to be washed, cleaned and sterilized. Dressing packs, containing everything from wet proof massive drainage and burn dressings to a single gauze sponge, and sterile packs for the operating room and obstetrics department are examples of currently available items that have been sterilized and tested under rigid controls.<sup>3</sup> The steadily growing list of other such items includes the following:

Obstetrical and surgical drapes; doctors' examining gowns; surgeons' gloves; knife blades; syringes and needles; blood lancets; specimen bottles; oxygen masks and tubes; oxygen tents; emesis basins; catheters; levine tubes; drainage sets; blood transfusion and intravenous sets; colostomy bags; stomach tubes; rectal tubes; blood sample containers; enema units; surgical kits; single-dose injectable medications; suture cutters and forceps; petrie dishes; lubricating jelly; and others.

In recent years the hospital has also turned to disposable paper

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<sup>3</sup>Celeste K. Kemler, "In Evaluating A Disposable, Consider Patient Care First," Hospitals, Journal of the American Hospital Association, Vol. 34, (June 16, 1960), 67-69.



products for effecting further economies in the professional care area. Substantially improved paper wraps have proved ideal for packaging and sterilizing many hospital supplies, such as syringes, needles, catheters, gloves and soft goods. Instead of cloth wraps to wash, mend and take up excessive storage space, a suitable paper wrap has been developed that can be quickly and easily handled, sterilized and thrown away. Diapers and underpads have long been established in the disposable field, making paper products even more common in hospitals. A more recent development has been the premoistened paper washcloth,<sup>4</sup> and a disposable cardboard waste receptacle which for hospitals is both practical and economical.

Food service department products.--There is also a definite trend in the food service department towards the use of prepackaged and disposable items. There has been a significant increase, for example, in the use of "convenience foods" and in disposable paper service. The paper creamer and sugar, salt and pepper shakers have been found both economical and quite acceptable; however, while functionally excellent, there continues to be some resistance to eating from paper plates and drinking from paper cups. The main objection is that the taste of food and drink is changed by paper. Experiments with paper service continues, however, with some manufacturers coating their paper products with plastic to make them more acceptable.<sup>5</sup>

Many new convenience foods are now available that make possible great changes in employee work schedules and in requirements for skilled labor. The current market includes a wide variety of appetizers, soups, entrees, vegetable dishes, cakes, pastries and breads. Some of these products require only thawing;

<sup>4</sup> DeWitt, Hospital Topics, (October, 1957).

<sup>5</sup> Charles U. Letourneau, "The Hospital of the Future," Hospital Management, (October, November, December, 1957).



others only re-heating. Others that are partially cooked require a simple final cooking process.<sup>6</sup> The most popular frozen foods in institutional trade are frozen vegetables, especially frozen French-fries, peas and cut corn; frozen fruit, such as blackberries, blueberries, boysenberries, cherries and peaches; juice concentrates, especially orange juice concentrate; and frozen poultry. Foods showing promise are boil-in-bag foods and other frozen entrees which need only to be heated and served, and dehydrofrozen foods, which are comparable in quality to foods frozen without dehydration. The use of prefabricated and pre-portioned meats also shows evidence of growth.<sup>7</sup>

#### Advantages Attributed to Prepackaged and Disposable Products

While the trend towards the use of prepackaged and disposable products in hospitals seems to be well established, the evaluation of the decision to use them continues. In general, prepackaged and disposable items cost more than the original product they are replacing when considered from the standpoint of initial purchase price. However, the end use cost of the products must be evaluated. Disposables eliminate some of the materials handling necessary for the standard item, and ultimately reduce personnel requirements.

Figures can be quoted from many studies to prove that disposables save money. Doctors, nurses, administrators, purchasing agents, pharmacists, and vendors have contributed articles to hospital periodicals supporting the contention that there is economy in apparent waste. The direct cost of many disposable equivalents is acknowledged to be higher than the use-per-unit cost of the reusable products; however, there are intangible factors, such as time saved in the central supply department and increased nursing time made available for

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<sup>6</sup> Downes, Hospitals, Journal of the American Hospital Association, Vol. 34, 66-68.

<sup>7</sup> "Frozen Foods: Uses and Management," Hospitals, Journal of the American Hospital Association, Vol. 35 (September 16, 1961), 93-102.



service to patients, that have been considered in determining the economic advantage of the one over the other.

The time and labor saved in the central supply department is a point well taken by those endorsing the use of disposable products. The work simplification that results from the use of such products may release highly skilled personnel in favor of semiskilled employees, or may eliminate the job altogether. If, for example, a hospital employs one person whose only job is to clean, wrap and autoclave hypodermic needles and syringes, then presumably, if it has no needles and syringes to clean, that employee is no longer needed. Again, if a hospital has one employee whose only job is to properly clean, patch, wrap and autoclave rubber gloves, and it begins to use disposable rubber gloves, then presumably it can take that individual off its payroll. Thus there will be two fewer people on the payroll because of using disposables.

Savings in preparation time made possible by prepackaged and disposable items allows nurses to administer more medications in the same amount of time. Furthermore, such items are safer; there is no chance for cross-contamination between patients. Another distinct advantage, and one that does much for the morale of nursing personnel, a factor that directly affects patient care, is that many of the supplies used on patients are difficult to clean. The catheter, the colon tube, the colostomy bag, and the enema can are examples of such items that have been replaced by disposable equivalents. A further advantage, when the patient load or work load becomes unexpectedly heavy, prepackaged and disposable products provide sterile supplies for ready use.

Disposables undoubtedly increase the need for storage space, as each hospital will be obliged to keep substantial supplies of disposables on hand. However, there is an advantage which may more than compensate for the money that may be spent for additional storage space; some hospitals undergoing expansion find that they do not need the glove washer, glove powdering equipment and the



syringe and needle washer when they use disposables. These items of equipment represent a cost of many thousands of dollars, and the savings should not be overlooked. Even in small expansion programs, one or two fewer autoclaves are necessary. With prepackaged and disposable supplies, requirements for autoclave space is considerably reduced.<sup>8</sup>

An example of direct economy in the use of disposable products is the new disposable plastic emesis basin. Research has shown that the cost of handling and sterilizing conventional emesis basins exceeds the cost of the disposable basins when purchased in quantities needed by most hospitals, and also provides one more individualized, personalized service to the patient. Sterile plastic intravenous and blood transfusion sets, used once and thrown away, have also been proven less costly, with today's hospital wage scales, than cleaning and re-using the so-called permanent sets.<sup>9</sup> Other such examples of proven economies with the use of prepackaged and disposable products will be discussed more fully in the following chapter.

In summary, the following features are claimed for prepackaged and disposable products by a significant number of professional people in the hospital field:

- (1) They are as good or better than the items they are replacing.
- (2) They reduce the amount of manpower needed to get materials to and from various locations throughout the hospital.
- (3) They effect a significant reduction in materials handling, such as cleaning, autoclaving, and make-ready.

As the comparative-cost spotlight is currently focused by the majority

<sup>8</sup> Kemler, Hospitals, Journal of the American Hospital Association, Vol. 34, 67-69.

<sup>9</sup> Dewitt, Hospital Topics, (October, 1957).



of hospital researchers on the disposable syringe and needle units, a more detailed listing of the features claimed for this item is presented in Appendix I.

### Prospective Developments

The professional patient-care area.--Almost all supplies in the hospital of the future will probably be prepackaged and disposable. This will eliminate much of the washing and cleaning presently required of the house-keeping department and may result in the entire elimination of the central service department. Ideas for the majority of the new disposables will probably come from within the hospital. The physician, nurse, department head and administrator will lead the way in suggesting new expendable items. Often, however, a manufacturer will develop a faster method of producing his product, putting the unit cost within the range of disposability. Close cooperation between the hospital and the manufacturer of hospital supplies will speed the development of these time-saving innovations.

The growth of disposables depends on ideas and raw materials. Ideas will come as people recognize ways to do their jobs faster and better. New plastics, metals and paper products will open the way to the fulfillment of these ideas. Gowns for patients' clothing and for surgical teams, made of suitable paper, are within the realm of possibility, and sheets and pillowcases will not always be a heavy laundry and maintenance expense. Almost any turn of the imagination will lead to a disposable hospital product to join the growing array. The result will be still greater economies in hospital operations.<sup>10</sup>

The food service department.--In the very near future disposable containers and utensils will probably gain favor in the food service department

<sup>10</sup>Ibid.



as paper food-serving dishware and tumblers that are attractive, heat-resistant and sturdy are perfected. This will eliminate much of the dishwashing and cleaning, and modern incinerators will eliminate the problem of garbage disposal. The entire left-over content of an individual meal and the disposable dishes will simply be bagged and placed in the incinerator, and incinerators will probably be located in various parts of the hospital to expedite disposal.<sup>11</sup>

The trend towards the use of convenience foods will probably be intensified. A new commercial process for quick freezing foods at temperatures well below 0°F. has improved the quality of frozen foods and provided the stimulus for the growth of freezing as an important method of food preservation. Improvements in freezing processes are still being made. Thirty years ago the frozen food business was in its infancy. The present growth of this industry may be only a hint of the growth still to come. Estimates of probable growth of foods that are just beginning to appear on the market, such as frozen prepared entrees and dehydrofrozen foods, range from mildly optimistic forecasts of a revolution in food service to a more modest prediction of merely continued growth.<sup>12</sup>

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<sup>11</sup>Letourneau, Hospital Management, (October, November, December, 1957).

<sup>12</sup>"Frozen Foods: Uses and Management," Hospitals, Journal of the American Hospital Association, Vol. 35, 93-102.



## CHAPTER IV

### HOSPITAL COST STUDIES AND PRODUCT COMPARISONS: CONVENTIONAL SUPPLIES VERSUS PREPACKAGED AND DISPOSABLE EQUIVALENTS

Although the use by hospitals of prepackaged and disposable items has increased greatly during recent years, and increasing numbers of articles that support the trend are appearing in professional publications, there are, unfortunately, a limited number of reports available considering comparative costs of these versus conventional products. Principal among the reasons for this situation is probably the high cost of this type of study. As it is necessary for the individual hospitals to bear the cost of such comparative studies, the trend has been to analyze only those frequently-used supplies that have wide application and on which obviously significant amounts of hospital labor are expended. Thus far, reliable hospital cost studies have been published for a very small percentage of the vast array of prepackaged and disposable items that are currently available. Products for which the most comprehensive studies are available include syringes and needles; wraps for sterilization of hospital supplies; surgeons' gloves; and, to much lesser extent, waste receptacles; oxygen tents; and a number of food service items, particularly convenience foods. The per-unit-use savings reported in the various cost studies for identical items are significantly consistent, tending to support their validity. Typical among the various reports are those presented in succeeding paragraphs and in Appendix II. An illustration of the typical comparative-cost study procedure is presented in Appendix III.



### Disposable Versus Re-Usable Hypodermic Needles and Syringes

In recent years, labor-saving disposable hypodermic needles and syringes have been offered by various manufacturers. These have gradually been introduced in a number of hospitals as administrators have come to recognize the many comparative disadvantages of so-called standard injection techniques. These disadvantages are most evident when the many operations involved in providing patients with injectable medications are traced through the various hospital departments.

In general, five main departments are involved in providing a patient with an injectable medication: purchasing, accounting, pharmacy, central supply, and the appropriate nurse's station. After the physician has written his orders, the ward nurse copies them from the doctor's-order-book to the patient's record and prepares a requisition to obtain the medication from the pharmacy. The pharmacy receives the requisition and sends the medication to the nurse's station.

Using the standard injection technique, the ten-cc vial which the nurse receives from the pharmacy is theoretically, but not actually, sufficient for ten one-cc injections. At the nurse's station a syringe must be matched with a prescribed length and gauge needle, which must be sharp and have no burrs. The nurse makes her selection from a quantity of needles that has just been received from the central supply department. These needles have all been sharpened, and all burrs have been removed; however, the nurse is often more particular than is central supply about what constitutes a sharp needle. The result is that she segregates and sends back for reprocessing a large number of needles which have not been used.

When using standard syringes with multiple-dose vials, the nurse seldom withdraws the exact dosage; usually slightly more is withdrawn than is needed,



to insure that the patient receives the prescribed amount. Prior to using the multiple dose vial, the nurse must sterilize the rubber cap through which the needle will be inserted.

After the nurse has completed the various injections she takes the used syringes back to the nurse's station and separates the needles. She then draws a solution into each syringe, flushes it out two or three times, and returns the superficially cleaned instruments to central supply for reprocessing. When the containers of used syringes and needles arrive at the central supply department, the syringes are taken apart and soaked in a disinfectant solution for several hours. The needles are treated in the same manner, and then cleaned. All needles needing processing are put aside for a nurse who sharpens them if they are dull or have burrs, reams them if they are blocked, and cleans them with ether. Some needles are sharpened by a machine. Dozens of needles may be shuttled back and forth between the nurses' stations and central supply.

Another operator cleans the syringes. Probably a liquid soap preparation is used, followed by several rinses in tap water. The syringes and needles which have passed inspection and are found to be in working order are then placed in a tray. Between twelve and twenty syringes and approximately twenty-four needles are put on each tray, and the entire tray is wrapped and placed in the autoclave for about 45 minutes.

Usually overlooked in arriving at the actual cost of administering injectable medications is the portion of the cost chargeable to the hospital's administrative departments. The purchasing department and the accounting department must process and handle purchase orders, bills, and inventory sheets for each separate item purchased. By the same token, storage records must be kept in the various locations where injectable equipment is stored. Using the standard injection equipment, the records in question must be separately maintained for purchases, bills, stocks of needles, syringes, syringe and needle



wraps, trays, pans, detergents and envelopes used in the production of sterile equipment or in facilitating its sterilization and handling.

In contrast, when single-dose, closed system injectable medications are used, only the cartridge-needle assembly, which comes in one piece, needs to be purchased, billed and stored, with corresponding reduction in the time spent by hospital personnel engaged in accounting and purchasing operations.

The closed-system, single-dose injection technique provides a maximum of simplicity and eliminates hidden hospital costs. Only a few seconds are required to place a sterile cartridge in a breech-loading syringe and to administer the injection. After the injection, the cartridge is discarded. The syringe, however, may be used repeatedly without sterilization being required. It is so constructed that it never comes in contact with the medication or with the patient's body fluids. The central supply department is at no time involved. Each sterile cartridge carries its own sterile needle, protected from contamination by a rubber sheath until the moment of injection. Every needle is sharp and used only once. The disposable equipment also allows the operator to aspirate, as is proper before making an injection, to insure that the needle is correctly placed.

In addition, the cartridge provides an accurate dose. The identity and the dosage of the medication are permanently printed on each cartridge. The ward nurse preparing several injections cannot get them mixed. As each cartridge contains but one dose, the hospital has an accurate accounting record, free of hidden costs, for every medication. Most important, however, the hospital saves expensive nursing time, which in a busy hospital amounts to several hours per nurse per day.

Studies conducted at several hospitals which have adopted the closed-system injectable medication technique have recently been published in professional hospital periodicals and pamphlets. In these studies, the costs of



all operations involved in providing patients with injectable medications have been carefully calculated after determining with a stop watch the amount of time spent by each individual in the appropriate hospital departments. Estimates were made of the cost of needles and broken syringes that had to be replaced and the cost of loss of medications. When all these costs were added, the price of making an injection became significantly higher than the pharmacy cost of the particular medication used, and the cost savings in using the disposable equipment were revealed to be considerable when applied to the volume of repetitive operations involved in the routine care of hospital patients.

There are basically four steps in providing a patient with an injectable medications: procurement; preparation for use; administration to the patient; removal of the equipment from the work area; and preparation for re-use. If the time involved in any step can be reduced or eliminated entirely, obviously there will be a cost savings to the hospital.

Cost study conducted in a North-East hospital.--At a North-East hospital, a study was recently made with a single injectable medication and it was found that each injection with a standard syringe, using the ten-cc multiple-dose vial cost 42.3 cents. This cost included raw material, nursing time, central supply time, and the time of the purchasing and accounting departments. In contrast, the total cost to the hospital of the single-dose, disposable injection unit which was used was 39 cents. The difference of 3.3 cents resulted from the reduction or complete elimination of costs attributed to the various departments involved, as well as the elimination of loss and breakage of needles and syringes.

The cost of the injection by the standard syringe method, using multiple-dose vials, was made up of the following:



|                            |             |
|----------------------------|-------------|
| Materials per dose         | .11         |
| Pharmacy time              | .01         |
| Nurses' time               | .13         |
| Central supply time        | .07         |
| Purchasing department time | .09         |
| Accounting department time | .013        |
| <br>Total cost             | <br>\$ .423 |

Following the adoption of single-dose, disposable syringes, breakage of syringes (which required replacement at the rate of five-dozen per month) was no longer a cost factor. This, at a price of \$18 per dozen, resulted in additional savings of approximately \$90 per month. A further savings of approximately \$29 per month resulted from the elimination of needle replacement at the rate of one gross of all sizes each month.<sup>1</sup>

Cost study conducted in a Mid-West hospital.--A time and cost study similar to that conducted at a North-East hospital undertaken by the nursing department at a Mid-West hospital revealed substantially greater savings with the disposable units than were reported by the former institution. Based on a savings in nursing time of approximately 15.4 seconds per injection and the complete elimination of central supply processing time, the cost savings was estimated at approximately 10 cents per injection. The results of the studies comparing the standard injection method with a method utilizing disposable syringe units were reported as follows:

|   | <u>Re-usable</u> | <u>Disposable</u> |
|---|------------------|-------------------|
| Average nursing unit time per injection<br>(in seconds) |                  |                   |
| Preparation time  | 51.5             | 60.2              |
| Administration time                                     | 96.6             | 83.6              |
| Disassembly time  | 13.2             | 2.1               |
| Total nursing time                                      | 161.3            | 145.9             |

<sup>1</sup>Leonard B. Crohn, "Hidden Injection Costs," Hospital Management, Vol. 88, No. 2 (August 1959), 124-126.



|  | <u>Re-usable</u> | <u>Disposable</u> |
|--|------------------|-------------------|
| Central supply processing time<br>(in seconds) |                  |                   |
| Collection time                                | 232.5            | None              |
| Sorting and cleaning time                      | 20.5             | None              |
| Packaging time                                 | 16.6             | None              |
| Autoclaving time                               | 21.8             | None              |
| Distribution time                              | 130.0            | None              |
| Total central supply processing time           | 421.4            | None              |
| Unit cost of supplies used per injection       |                  |                   |
| Syringes and needles                           | \$ .014          | \$ .150           |
| Cleaning and autoclaving materials             | .024             | None              |
| Cost of nursing unit time                      | \$ .095          | \$ .085           |
| Cost of central supply processing time         | .193             | None              |
| Cost of supplies used                          | .038             | .150              |
| Total cost attributed to one injection         | \$ .326          | \$ .235           |

In addition to a cost savings of approximately 10 cents per injection, the technique of administration was considered much improved with the utilization of disposable units. As a result of the studies, it was recommended that disposable units be used almost exclusively for intramuscular injections.<sup>2</sup>

#### Disposable Versus Re-Usable Gloves

To explore the possibility of improving efficiency by the use of disposable rubber gloves, a cost study was undertaken by a Mid-West hospital in which the processing of reusable gloves in the central supply department and the laundry was examined in detail.

The study began with an examination of the techniques used in processing reusable gloves. Soiled gloves were accumulated daily by central supply and sent to the laundry where they were shaken to remove any glass, metal or other foreign substance. The gloves were then washed and rinsed for thirty minutes at 110°F., with the last rinses containing powder. They were tumbled in the washer to remove excess water and then placed in the tumbler with powder. After being tumbled for 30 minutes at 110°F. the gloves were placed in mesh bags

<sup>2</sup>Carl I. Flath, "Study Finds Time, Money Saved With Disposable Units," Hospital Topics, (June 1958).



and returned to the central supply department. Because they frequently contained moisture, the gloves in the bag were removed and placed on shelves to complete the drying process. Once every four hours during the next 24 hours, the gloves were tossed and turned on the shelf. They were then tested, sorted, packaged, sterilized and sent to the stations.

To test a glove, air was introduced, either by manual scooping or by use of an airstream, causing the glove to stretch. By placing the stretched portion of the glove near the ear, the inspector could tell whether the glove was perforated. The glove was visually examined and finally pulled to determine the degree of elasticity. It was then placed in a bin compartment by size.

New and used gloves which the inspector considered to be of sufficient quality were removed from the bins and placed in the powder machine for four minutes. They were kept separated and powdered by size and then removed to the work table where the cuffs were turned up and the gloves paired. A matched pair was placed on a green cloth of 140 count double muslin. Paper separators were inserted, one around the thumb tip over the outside of the thumb and between the rubber where the cuff was folded on the palmar side, and the second on the back side between the cuff and glove. In addition to the two paper separators, a single cardboard chip was inserted inside the glove. The paper and cardboard separators were used to keep the rubber away from itself and to allow steam to reach all surfaces during autoclaving. The gloves were next laid side by side and the muslin cloth was folded five times in such a way as to pocket each glove. Tie strings were wrapped around the cloth, a piece of sterilizer indicator tape affixed, and the package marked to show the size of the gloves and the expiration date. To sterilize the gloves, ninety-six packages were stacked in a staggered manner to allow the steam to penetrate. The basket in which the gloves were stacked was inserted in the autoclave and exposed to steam for 30 minutes. After autoclaving, the gloves remained in the basket one hour to cool before



being stored on the shelves.

The number of uses gained from each glove was sought to determine the cost to be assigned to each use. A record was kept of gloves ordered by and sent to the using units. The data, as gathered, permitted the calculation of a mean of 3.021 and a standard deviation of plus or minus 1.62 uses. However, a mean use approaching 4.5 was considered to be more accurate. At a purchase cost of 21 cents and a usage rate of 4.5, the per-use cost was determined to be 4.67 cents.

The processes of testing, inspecting, sorting and placing gloves in bins in lots of fifty were performed by four different employees. The time involved ranged between 36 and 40.8 seconds per glove, depending upon the ability and experience of the inspector. Translated into direct labor dollars at the rate of \$1.375 per hour, this meant a cost range between 1.368 and 1.55 cents per glove.

The packaging of a pair of gloves involved the use of two cardboard chips at .29 cent each and four paper separators at .692 cent each. Time studies of the powdering and matching operation of eight forty-pair lots indicated a range of means between 40 and 45 seconds per pair of gloves. The average of the means was 42.88 seconds per pair. Translating time into dollars produced a per-pair labor cost of 1.629 cents. Powder cost was .2 cent per pair.

Wrapping time was found to be 82.86 seconds per pair. Using the same wage of \$1.375 per hour, the wrapping cost amounted to 3.149 cents per pair of gloves. Green cloth wrap or envelope cost was .1 cent per pair. These figures yielded a total package cost of 8.426 cents per pair of re-usable gloves, and a total per-use cost of 14.555 cents.

It was thought that some economies could be effected by streamlining the method of processing the re-usable gloves. By making changes in the packaging procedure, such as eliminating the paper separators, which were not



believed essential to the sterilizing process, the per-use cost of re-usable gloves was reduced to 13.996 cents. The per-use cost of disposable gloves was determined to be 13.516 cents, or .48 cent less costly than re-usable gloves.<sup>3</sup>

#### Paper Versus Muslin Sterilizing Wraps

Incomplete and conflicting data on costs per use, and conflicting statements concerning specifications and safety of various types of sterilizing wrappers prompted a study by a New England hospital to determine which type of wrapper is most suitable, most efficient, and most economical for autoclaving hospital supplies. Costs were determined by the use of a time study in which a watch calibrated in decimal minutes was used. In many instances the unit of time was so small that it was necessary to define a step by checking it in combination with a group of motions for which the time had previously been determined. Time units involved in each step were obtained by observing the actual performance of handling each type of wrapper under exactly the same conditions, the only variable factor being the texture and characteristics of each type of material. In the case of muslin wrappers, only the small size could be laid flat on the average storage shelf; the medium and large sizes required folding of individual wrappers to prevent wrinkling. Large size paper wrappers, however, could be piled and the entire pile folded once. Therefore, in the wrapping technique, it was necessary to reach for, unfold and place each individual muslin wrapper, whereas with the paper wrappers the entire pile could be unfolded and placed in one handling.

The study revealed that approximately three times as many paper wrappers can be stored in the same area as the comparably-sized muslin wrappers, and that the storage of paper wrappers is far more easily accomplished than the storage

<sup>3</sup>Rufus W. Manderson, "Disposable and Re-Usable Gloves: A Cost Comparison," Hospitals, Journal of the American Hospital Association, Vol. 34 (August 16, 1960), 65-68.



of muslin bolts. From the time of receipt of the paper wrappers, only one storage location was necessary until their issuance to central supply. Muslin wrappers, however, required several interdepartmental transfers, each in turn requiring temporary storage.

Another distinct disadvantage of the muslin wrappers in comparison with paper equivalents was that the former had to be manufactured in the hospital sewing room, and the level of work in this department was too high to allow preparation of a supply of wrappers in advance of demand. When an order for additional wrappers was placed by the central supply department, the routine in the sewing room was interrupted and delayed. This situation pointed up the probability that in the event of an emergency, or when an unusually high rate of wrappers need repairs, the central supply department could not be assured of a supply sufficient to meet requirements. A plentiful supply of paper wrappers, however, can readily be made available. When an order for additional paper wrappers is placed, the transportation of a case of the correct size from the storeroom to central supply can be accomplished in a matter of minutes.

Material used in the manufacture of muslin wrappers must be purchased in seventy-two inch bolts. The wrappers are most commonly prepared in three sizes: small, medium and large, which are fifteen, thirty and forty-five inch squares respectively. It is generally considered not economically feasible to add to the burden of the sewing room by requiring additional sizes. Because of this restriction, it was observed, frequently an item is too large for a wrapper of one size, yet much too small for the next available size. This resulted in greater wrapping difficulty and loss of autoclave and storage space. Paper wrappers, on the other hand, are available in a variety of sizes, allowing the use of a correct wrapper for every item. This resulted in an estimated 25 percent savings in autoclave space per load. In addition, it was observed that autoclaving time was reduced by five minutes per load when utilizing paper



wrappers as a result of a shorter drying time. This factor made possible the running of an extra load per day when autoclaving time was at a premium.

The steps in the manufacture of a finished muslin wrapper prior to its first delivery to central supply for initial use include cutting, sewing, stamping and laundering. In addition to the cost of material and labor involved in each of these steps, a three percent-of-cloth cost for purchasing and handling and a two percent-of-cloth cost for storage were utilized in determining the per-use cost. It was determined that the muslin wrappers can withstand an average of fifty uses, and require an average of four repairs.

The per-use cost of paper wrappers was determined by adding to the cost of each sheet the three percent-of-material cost which was allocated to the muslin wrappers for purchasing and receiving time, but only one-third of the two percent charge for storage and handling, as it was determined that three times as many paper wrappers can be stored in a given area and that transportation and interdepartmental handling are almost eliminated for this type wrapper.

The comparative costs of the muslin and paper sterilizing wrappers were determined as follows:



| Muslin Wrappers:                            | <u>Small</u> | <u>Medium</u> | <u>Large</u> |
|---|--------------|---------------|--------------|
| <u>Manufacturing costs</u>                  |              |               |              |
| Square inches per wrapper                   | 512          | 2,048         | 4,608        |
| Cloth cost per wrapper at 68 cents per yard | \$ .1343     | \$ .5372      | \$ 1.2087    |
| Cutting and sewing                          | .0381        | .0570         | .0775        |
| Stamping                                    | .0030        | .0051         | .0080        |
| Laundering at 5.4 cents per pound           | .0090        | .0270         | .0540        |
| Purchasing and receiving time               | .0040        | .0171         | .0363        |
| Storage and handling                        | .0027        | .0107         | .0242        |
| Total manufacturing costs                   | .1911        | .6541         | 1.4087       |
| Cost per fifty uses                         | .0038        | .0131         | .0282        |

### Handling costs

|   |          |          |          |
|---|----------|----------|----------|
| Repairs (four per fifty uses prorated)        | .0016    | .0016    | .0016    |
| Laundering                                    | .0090    | .0270    | .0540    |
| Sorting and inspecting                        | .0018    | .0025    | .0036    |
| Wrapping costs                                | .0063    | .0092    | .0097    |
| Total handling costs per fifty uses           | .0187    | .0403    | .0689    |
| Total manufacturing and handling cost per use | \$ .0225 | \$ .0534 | \$ .0971 |

### Paper Crepe Wrappers:

|                               |                 |                 |                 |
|-------------------------------|-----------------|-----------------|-----------------|
| Cost per sheet                | \$ .0134        | \$ .0461        | \$ .0787        |
| Purchasing and receiving time | .0004           | .0014           | .0024           |
| Storage                       | .0001           | .0003           | .0005           |
| Handling                      | .0080           | .0096           | .0149           |
| <b>Total cost per one use</b> | <b>\$ .0219</b> | <b>\$ .0574</b> | <b>\$ .0965</b> |

\*While the finished wrappers measure fifteen, thirty and forty-five inches square respectively, they must be cut more than twice the size indicated to allow for a double thickness, necessary to maintain sterility, and to allow for hemming and shrinkage.<sup>4</sup>

## Disposable Versus Re-Usable Oxygen Tents

The re-usable oxygen tent, which is currently marketed at a retail price of \$15, can withstand, on the average, about seven uses. At this price and rate of usage, the per-use cost amounts to approximately \$2.14. Adding to this the

<sup>4</sup>Jean E. Christie, "Muslin vs. Paper Autoclave Wrappers - A Hospital Cost Study," Hospital Topics (March, April, 1957).



cost of cleaning the tent after each use, which at current hospital wage rates amounts to approximately \$1.25, the per-use cost of the re-usable tent becomes \$3.39.

A disposable oxygen tent is currently marketed by a manufacturer of hospital supplies for \$25 per dozen and is limited to one patient use. This amounts to approximately \$2.08 per use. By adopting the disposable tent, therefore, it would appear that hospitals can realize a savings of \$1.31 per use.<sup>5</sup>

#### Disposable Versus Conventional Waste Receptacles

A disposable cardboard waste receptacle has been developed by a national manufacturer which is especially designed for use in hospital waste disposal. According to a recent hospital cost study, the disposable system compares favorably in cost with the more conventional methods. Based on an average use of forty boxes, the material cost per day amounts to approximately nine dollars. As an offset to the material cost, however, there is a labor savings of six hours per day. This absolute savings in labor time allowed the release of one employee from the janitorial service.

The cardboard waste receptacles completely eliminated the need for relatively expensive galvanized cans, which with daily handling, steam sterilization, etc. can withstand an average six months usage. The elimination of the conventional receptacles represented a minimal savings of an additional one dollar per day, depending upon the original cost and durability of the cans. Less tangible savings accrued in the reduced amount of steam, water and electricity used in operating an automatic can washer.<sup>6</sup>

<sup>5</sup> Letter from Mr. William R. Evans, Sales Manager, Mist O<sub>2</sub> Equipment Company, Oakland, California, July 20, 1961.

<sup>6</sup> Robert R. Cadmus, "One-Use Waste Receptacles Minimize Infection Spread," Hospitals, Journal of the American Hospital Association, Vol. 32, (December 16, 1958), 82-84.



### Convenience Foods Versus Unprocessed Fresh Foods

Cost comparisons between convenience foods and comparable unprocessed fresh foods are practically non-existent, or at least difficult to obtain, perhaps for the reason that the expense involved in conducting such a study would be prohibitive for institutions that would be most interested in such comparisons. It is generally conceded, however, that most convenience foods make possible considerable savings in time and labor. Where such studies are conducted on a limited scale, the cost of management time saved by the convenience items, and the elimination of space and preparation equipment are rarely considered. With only the labor savings considered, however, there is in many cases a price advantage in using some form of convenience food rather than having the same item prepared in the hospital kitchen.

A study was recently reported in which the cost of preparing French-fried potatoes to the final-frying stage, the delivered state of frozen French-fries, was determined to be 2.4 cents more costly than the equivalent convenience product. The study, conducted in an employee dining room by a food service management firm, revealed that the processing time for one-hundred pounds of potatoes to the comparable delivered state of frozen French-fries required two hours and fifty minutes, for a labor cost of 8.4 cents. Adding to this the cost of potatoes, 12.7 cents per pound, and the shortening absorbed in the first blanching step, 1.3 cents per pound, the cost per pound of ready-to-fry French-fries amounted to 22.4 cents. This was 2.4 cents more costly than the prevailing price of frozen French-fries.<sup>7</sup>

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<sup>7</sup>"Frozen Foods: Uses and Management," Hospitals, Journal of the American Hospital Association, Vol. 35, 93-102.



### Individualized Versus Bulk Food Service Accessories

According to a nation-wide supplier of individual-size salt and pepper packets, well over fifty percent of the hospitals in the United States are currently using these products. This has been accomplished largely through very effective sales promotion in which absolute economy is convincingly demonstrated, even with conservative cost estimates for the various elements that make up the total expense to the hospital when using these products in bulk.

The replacement costs of broken and lost salt and pepper shakers, for example, are estimated at 40 cents per patient per year. An average patient uses about 11 cents worth of salt per year for table seasoning and about 80 cents worth of pepper. Labor costs per patient per year for filling salt and pepper shakers is estimated at \$3.20, based on 60 cents per hour as a basic hourly rate, which of course is low, and an estimated one minute per day spent in filling salt and pepper shakers. This actually amounts to \$3.65 per patient per year; however, the figure is reduced to \$3.20, as the actual time spent in filling shakers would probably be slightly less than one minute.

Labor cost for washing, sterilizing and drying salt and pepper shakers is estimated at \$3.20. This, added to the previous cost, amounts to \$7.71 per patient per year for maintaining ordinary salt and pepper shakers as compared with an approximate cost of \$3.75 for individualized prepackaged salt and pepper packets, which currently are marketed at four packets for one cent.<sup>8</sup>

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<sup>8</sup> Letter from Mr. Don C. Edmonson, Institutional Products Manager, Diamond Crystal Salt Company, St. Clair, Michigan, July 31, 1961.



## CHAPTER V

### SUMMARY AND CONCLUSIONS

Newspapers and popular and professional periodicals have been publishing increasing numbers of articles concerning the steadily rising cost of hospital care. Without examining the many facets of the cost spectrum one might readily suspect that today's hospitals are inefficiently managed. True there is always room for improvement in administrative procedures, but it would be erroneous to charge that inefficient management is responsible for the inflationary trend.

Since the end of World War II, hospitals have undergone unprecedented changes. Dramatic improvements have been made in facilities and equipment, in techniques, and in the overall philosophy of patient care. Many diagnostic and therapeutic facilities considered essential in hospitals today were not available as recently as five years ago. Efforts to provide the latest technical equipment and facilities, coupled with increasing costs of labor and supplies, are all factors contributing to the upward spiral in hospital costs.

Several factors indicate that the inflationary spiral will continue in the years ahead:

(1) The accelerating pace of development in medical technology will probably be the largest single factor responsible for future increases. Accompanying the increase in the number and complexity of scientific procedures will be the need for new and expensive technical equipment and for more and better qualified people to operate it. The cost for these developments will



be high.

(2) Automation in the manufacturing industries will continue to increase the rate of production per labor hour, which will result in a continuing rise in wage levels. Obviously, hospitals will find it necessary to increase their wage levels at the same pace if they are to compete successfully with manufacturing industries in the recruitment of qualified personnel.

(3) Together with the necessity for constant upward wage adjustments is the probability of a further shortening of the work week. The thirty-hour week possibility in industry, which must be matched by the hospital, will further increase the number of employees for each position which must be manned on a twenty-four hour basis.

(4) Professional organizations will continue their efforts to improve the educational, economic and social status of their members. This will be accomplished largely through the establishment of higher educational standards and through encouragement of legal licensure. These may be desirable objectives, but they will undoubtedly push hospital costs upward.

Professional people in the hospital field are fully cognizant of these inflationary forces, and although the competitive pressures which impel industry carefully to study every productive procedure in order to control and reduce costs do not exist among hospitals, hospital administrators and medical staffs are not sitting idly by while costs continue to climb. Numerous articles appearing in professional hospital literature indicate that much progress is being made in the evaluation and adoption of labor-saving procedures and devices. Significant economies in the dietary department, central supply, operating rooms, laundry and other departments are being widely reported. In the area of central supply, for example, there is a steady trend towards increased utilization of prepackaged dressings and disposable syringes, needles and



rubber gloves. The labor hours previously required to package and sterilize such materials were substantial. Another example is the trend towards the use of sterile disposable drapes, towels and wrappers in the operating and delivery room suites. These and similar innovations have resulted in significantly reduced labor requirements in these areas and throughout the hospital.

Along with the increase in the use of prepackaged and disposable products, the principles of automation are being applied where applicable and economically feasible. Although opportunities for mechanized procedures in the area of personal service to the patient have been quite limited, such innovations have been readily adopted in non-professional patient-care areas. The business and accounting offices, food service and, more recently, the laundry are notable examples of non-patient-care departments which have made progress in the adoption of mechanized procedures.

It is evident, however, that administrators and hospital staffs must intensify their efforts to further reduce and control costs. Changes, which have been occurring rapidly, will no doubt accelerate in the future because of the increasing emphasis on medical research and on research in general.

The fact that increasing portions of the hospital cost dollar are being used to defray labor expenses indicates that effective use of personnel is a major factor in combating the inflationary trend. Hospitals must operate on a twenty-four hour day, seven day week basis, which creates unavoidable labor standby service. This factor makes mandatory careful and continuous study of all aspects of labor utilization. The introduction of more labor-saving equipment and devices, particularly disposables, should be the objective of cost reduction programs.

The vast array of labor-saving devices currently available has been made economically feasible because manufacturers can afford the heavy capital expense of equipment suitable for turning out enormous quantities at a low unit



cost. In many instances they can afford to develop an item, produce it, absorb a heavy sales cost, make a profit, and still do it at less cost to the hospital. The reason for this is obvious: the manufacturing process is mechanized, while the hospital must rely principally on manual labor. As manufacturers of hospital products develop new procedures that place production costs within the realm of disposability, there will inevitably be many more such products to assist the hospitals in their efforts to reduce and control operating costs. In this regard, hospitals must not only continue to evaluate the increasing numbers of prepackaged and disposable items made available, but they must also help to expedite their development by contributing ideas of their own.

In addition to increasing the numbers of products in disposable form, much more can be done to promote the adoption of mechanized procedures in the non-professional patient-care activities, particularly in those departments performing clerical procedures. Hospitals require a tremendous number of records. These records must be accurate and, in many instances, must be processed rapidly. Computers were designed for this purpose. Their application to hospital data processing is an obvious step. There will surely be more, better, and less expensive automatic data processing equipment specifically designed for hospital use. Such equipment, which would automatically summarize patients' records, provide abstracts for insurance offices, prepare bills, keep expense accounts, make payrolls and yield epidemiological data is not too remote a possibility.

Much more must also be done towards the development of automatic equipment for use at the patient's bedside, particularly in the case of those patients requiring constant care and attention. More automation in this area seems a logical step, as much of the work involved is of a routine nature. Machines can be developed to perform many of the routine tasks much more efficiently than people. The trend toward the establishment of intensive care units



for post-operative and seriously ill patients makes the adoption of a patient monitoring system, such as that used in the manned space flight program, economically feasible in this patient-care area. With the use of this and more such devices as those described in Chapter II, the nurse and the physician will be able to care for many more patients in the same amount of time.

In the final analysis, much planning and teamwork is required to keep hospital costs under control, and at the same time keep pace with the increasing complexities of modern medical technology. The area in which the greatest economies can be achieved, and which should receive the very serious attention of hospital administrators, is the utilization of personnel. Needless waste of skilled manpower must be avoided by adopting more modern labor-saving supplies and equipment.



APPENDIX I

---

THE BENEFITS  
OF THE DISPOSABLE  
INJECTION SYSTEM



## BENEFITS

## FOR THE PATIENTS

The disposable syringe injection system provides these benefits:

1. A personalized injection system consisting of an individually wrapped syringe and needle combination used once and discarded
2. Minimum handling by the nurse avoids touch contamination since the unit is preassembled and ready for use.
3. Proven sterility and nonpyrogenicity...Produced by mass production and quality controlled methods; thoroughly animal tested with a control number on each unit.
4. Plunger packaged in the "out" position...no chance for the airborne contamination
5. Only sterile air enters the vial. Safer use of multiple-dose vials.
6. Sharp, burr-free needle
7. Syringe and needle protected from contamination while carrying to the patient after filling
8. Silicone-coated barrel facilitates blood withdrawal and increases accuracy of blood tests because of less hemolysis and clotting
9. Eliminates inaccuracy of tests resulting from traces of previously used testing material existing in re-usable syringe
10. Eliminates allergic reactions from inadvertant nebulization of residual drugs to other syringes and needles while processing
11. Eliminates problems of alkali leaching from ground surfaces of barrel or plunger while autoclaving.
12. Eliminates problems created by detergent residue resulting from inadequate rinsing
13. Eliminates all cross infection such as hepatitis, etc.
14. Eliminates moisture in syringes which is an excellent bacterial growth medium.



## BENEFITS

## FOR ADMINISTRATION AND COST ACCOUNTING

The evaluation of the cost of the hypodermic injection system is a study in itself, with which we deal separately. However, from the standpoint of cost accounting, the disposable system yields a number of benefits which deserve to be considered individually.

1. Known cost per injection
2. Unit injection cost not dependent on volume or census
3. Eliminates medication loss
  - A. Backflow and leakage
  - B. Freezing and sticking
  - C. Perfect suction insures full number of dosages from multiple-dose vials.
4. Eliminates depreciation and maintenance of equipment
5. Inventories of injection equipment can be related directly to census
6. Time and sick-leave pay to injured personnel are saved
7. Cost studies available if requested
8. Reduces double-needle usage
9. Improved public relations
10. Can standardize on fewer needle sizes
11. Substitute less expensive supply dollars for expensive labor dollars



## BENEFITS

## FOR THE NURSES

The disposable hypodermic injection system increases nursing efficiency on the floors, and provides these benefits:

1. Easily identifiable sizes and gauges
2. Package easy to open
3. Trouble free - no plugged needles, frozen syringes, or duplication of work
4. Perfect suction every time
5. Stable plunger -- no "wobble"
6. Syringe will not roll off medication tray
7. Wide flanges insure good grip
8. No assembly, dismantling, rinsing, or soaking; saves one minute per injection.
9. Easily destroyed and disposed of
10. Avoidance of contact sensitization from residual drugs
11. Calibrations accurate, syringe easy to fill
12. No confusion in adopting new technique -- thoroughly planned installation program.



## BENEFITS

## FOR CENTRAL SUPPLY

The disposable hypodermic injection system provides these benefits:

1. Eliminates 26 steps in handling and processing a syringe
2. Eliminates 31 steps in hand-processing a needle
3. Relieves hours for other tasks -- time saved can be consumed in:
  - A. Processing supplies now done on the floors
  - B. Re-organizing personnel by transfer to short-handed departments
  - C. Not re-hiring when vacancy occurs
  - D. Not hiring additional personnel when census increases or hospital expands.
4. Simplifies training and supervision
5. Conserves space -- especially when special work areas are reserved for needles and syringes.
6. Provides more space in sterilizer for other items
7. Provides a constant flow of syringes independent of personnel limitations in cases of emergency
8. Simplifies distribution
9. Eliminates occupational hazard of contact sensitization from residual drugs
10. Eliminates cut hands and pricked fingers
11. Provides a control card to check issues versus injections; eliminates pilferage and unused syringes
12. Eliminates odd-size processing problems
13. Remains sterile indefinitely in unbroken or unopened package.



## APPENDIX II

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THE COST OF USING DISPOSABLE SYRINGES: RESULTS  
OF HOSPITAL COST STUDIES

In order to determine accurately the cost of using disposable syringes, a complete analysis of the hospital must be made to determine how much the present system costs and to forecast the dollar outlay for disposable syringes. However, averages of studies performed in other hospitals can be of value in estimating costs in any individual hospital. It has become well established that the type of system utilized to process re-usable equipment is the primary determinant of cost, not the size or classification of the hospital.

The studies presented on succeeding pages can help hospitals evaluate maximum and minimum costs of the various types of re-usable processing systems of injection equipment. The samples are, however, too small and unrepresentative of the universe for making categorical assumptions.<sup>1</sup>

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<sup>1</sup>The studies presented herein were compiled by Pharmaseal Laboratories, Incorporated and furnished the author by J. D. McClure, the Syringe Product Manager of Pharmaseal Laboratories, for the purpose used.



A STUDY OF EIGHT HOSPITALS

Using Individually-Packaged Needles and the "Boat" Method of Processing Syringes versus Disposable Syringes

| HOSPITAL LOCATION | AVERAGE DAILY CENSUS | ANNUAL INJECTIONS | PER CENT UNUSED SYRINGES | LABOR COST PER UNIT | MATERIALS COST PER UNIT | TOTAL RE-USABLE COST | DISPOSABLE SYRINGE COST |
|-------------------|----------------------|-------------------|--------------------------|---------------------|-------------------------|----------------------|-------------------------|
| New-Eng.          | 342                  | 290               | 182,900                  | 11.0%               | \$0.026                 | \$0.084              | \$0.110                 |
| South             | 249                  | 197               | 100,400                  | 16.7%               | .020                    | .058                 | .078                    |
| Mid-West          | 182                  | 156               | 84,600                   | 18.1%               | .036                    | .031                 | .067                    |
| Mid-Atl.          | 181                  | 180               | 107,000                  | 34.1%               | .043                    | .026                 | .069                    |
| Mid-West          | 160                  | 137               | 67,400                   | 20.8%               | .035                    | .060                 | .095                    |
| Mid-West          | 360                  | 325               | 158,500                  | 12.5%               | .044                    | .050                 | .094                    |
| Mid-Atl.          | 399                  | 294               | 142,600                  | 38.0%               | .064                    | .033                 | .097                    |
| Mid-West          | 450                  | 326               | 158,700                  | 15.2%               | .040                    | .070                 | .110                    |
| Average           | --                   | --                | -----                    | 20.8%               | .039                    | .052                 | .091                    |
|                   |                      |                   |                          |                     |                         |                      | .109                    |



A STUDY OF NINE HOSPITALS

Using Individually-Packaged Syringes and Individually-Packaged Needles versus Disposable Syringes

| HOSPITAL LOCATION | BEDS | AVERAGE DAILY CENSUS | ANNUAL INJECTIONS | PER CENT UNUSED SYRINGES | LABOR COST PER UNIT | MATERIALS COST PER UNIT | TOTAL RE-USABLE COST | DISPOSABLE SYRINGE COST |
|-------------------|------|----------------------|-------------------|--------------------------|---------------------|-------------------------|----------------------|-------------------------|
| Mid-Atl.          | 250  | 218                  | 106,300           | 9.9%                     | \$0.037             | \$0.066                 | \$0.103              | \$0.101                 |
| Mid-West          | 293  | 262                  | 118,900           | 16.0%                    | .030                | .058                    | .088                 | .101                    |
| South             | 311  | 238                  | 140,300           | 25.9%                    | .035                | .062                    | .097                 | .108                    |
| Mid-West          | 170  | 147                  | 67,100            | 21.0%                    | .082                | .052                    | .134                 | .112                    |
| South             | 150  | 125                  | 66,300            | ---                      | .033                | .055                    | .088                 | .096                    |
| New Eng.          | 395  | 350                  | 193,400           | 18.0%                    | .032                | .070                    | .102                 | .128                    |
| Mid-Atl.          | 155  | 129                  | 60,300            | 19.7%                    | .048                | .056                    | .104                 | .122                    |
| Mid-Atl.          | 336  | 265                  | 128,500           | 12.9%                    | .051                | .063                    | .114                 | .093                    |
| West              | 300  | 290                  | 159,800           | 14.0%                    | .078                | .048                    | .126                 | .105                    |
| Average           | ---  | ---                  | ---               | 17.2%                    | .047                | .059                    | .106                 | .107                    |



A STUDY OF FIVE HOSPITALS

## Using Disposable Needles and the "Boat" Method of Processing Syringes versus Disposable Syringes

| HOSPITAL LOCATION | BEDS | AVERAGE DAILY CENSUS | ANNUAL INJECTIONS | PER CENT UNUSED SYRINGES | MATERIALS COST PER UNIT | LABOR COST PER UNIT | TOTAL RE-USABLE COST | DISPOSABLE SYRINGE COST |
|-------------------|------|----------------------|-------------------|--------------------------|-------------------------|---------------------|----------------------|-------------------------|
| Midwest           | 448  | 340                  | 171,516           | 20.0%                    | \$0.00                  | \$0.075             | \$0.115              | \$0.103                 |
| Midwest           | 131  | 191                  | 60,060            | 18.0%                    | .022                    | .066                | .088                 | .093                    |
| Mid-Atl.          | 236  | 102,180              | 38,448            | .014                     | .112                    | .126                | .126                 | .126                    |
| Mid-Atl.          | 511  | 456                  | 277,500           | -----                    | .015                    | .111                | .126                 | .112                    |
| Mid-Atl.          | 143  | 115                  | 52,156            | 26.4%                    | .014                    | .094                | .108                 | .110                    |
| Average           | ---  | ---                  | ---               | 25.7%                    | .021                    | .092                | .113                 | .109                    |



A STUDY OF FIVE HOSPITALS

Using Disposable Needles and Individually-Packaged Syringes versus Disposable Syringes

| HOSPITAL<br>LOCATION | BEDS | ANNUAL<br>CENSUS | INJECTIONS | PER CENT<br>UNUSED<br>SYRINGES | LABOR COST<br>PER UNIT | MATERIAL<br>COST PER<br>UNIT | TOTAL             | DISPOSABLE<br>SYRINGE<br>COST |
|----------------------|------|------------------|------------|--------------------------------|------------------------|------------------------------|-------------------|-------------------------------|
|                      |      |                  |            |                                |                        |                              | RE-USABLE<br>COST |                               |
| West                 | 350  | 193              | 121,300    | 9.3%                           | \$0.038                | \$0.083                      | \$0.128           | \$0.106                       |
| Mid-West             | 200  | 178              | 83,512     | 16.1%                          | .037                   | .133                         | .170              | .105                          |
| Mid-West             | 368  | 340              | 207,100    | 14.8%                          | .017                   | .126                         | .143              | .115                          |
| Mid-West             | 200  | 194              | 71,700     | 2.8%                           | .036                   | .119                         | .164              | .124                          |
| Mid-West             | 384  | 259              | 103,700    | 26.7%                          | .032                   | .130                         | .192              | .118                          |
| Average              | ---  | ---              | ---        | 13.9%                          | .032                   | .118                         | .150              | .114                          |



## COMMENTS

1. The average daily census multiplied by 500 is a good indication of actual injections a short-term general hospital will perform.
2. The injection percentage by type in the average hospital will be close to:

|            |     |
|------------|-----|
| 2 cc.      | 72% |
| 5 cc.      | 14% |
| 10 cc.     | 4%  |
| 20 cc.     | 3%  |
| 30 cc.     | 1%  |
| Insulin    | 3%  |
| Tuberculin | 2%  |
| 50 cc.     | 1%  |

If pre-filled cartridges or devices are used, subtract these from the appropriate type.

If blood sample evacuated tubes are not used, the percentage of 10 cc. should be increased at the expense of 2 cc. and 5 cc.



## APPENDIX III

## SYRINGE COST SURVEY

- INDEX -

Form A Annual Cost of Supplies and Equipment  
Form B Injection and Processing Study  
Form C Central Supply Processing Count  
Form D Central Supply Time Study  
Form E Fringe Labor Benefits  
Form F Central Supply Labor Costs Study  
Form G1 Nursing Service -- Summary of Injection Count  
Form G2 Daily Injection Record Sheet (Sample)  
Form H1 Medication Loss  
Form H2 Medication Loss Interview Sheet (Sample)  
Form I Disposable Syringe Purchase Costs  
Form J Summary



## SYRINGE COST SURVEY

## ANNUAL COST OF SUPPLIES AND EQUIPMENT

## HOSPITAL

**SUPPLY OFFICER**

TO

|      |  |    |       |
|------|--|----|-------|
| (1)  | Syringes                                     | \$ | _____ |
| (2)  | Needles*                                     |    | _____ |
| (3)  | Resharpening Costs (if done outside)         |    | _____ |
| (4)  | Ether  |    | _____ |
| (5)  | Cotton                                       |    | _____ |
| (6)  | Applicators                                  |    | _____ |
| (7)  | Rubber Bands                                 |    | _____ |
| (8)  | Constriction Tubes                           |    | _____ |
| (9)  | Gauze  |    | _____ |
| (10) | Surgical Cleaner                             |    | _____ |
| (11) | Linen Wrapper and Packets                    |    | _____ |
| (12) | Needle Packs                                 |    | _____ |
| (13) | Syringe Packs                                |    | _____ |
| (14) | Depreciation on Equipment**                  |    | _____ |
| (15) | Maintenance on Equipment**                   |    | _____ |
| (16) | Gas or Electricity for Sterilizing Equipment |    | _____ |

\*If the hospital is using disposable needles, extend cost to the entire year if this is a recent change. Costs must be determined under the present system. For instance, if disposable needles are used at the rate of \$200 per month, (2) would be shown to amount to \$2,400.

\*\*Usually averages about 10% per year of original purchase price.



## SYRINGE COST SURVEY

INJECTION AND PROCESSING STUDY

HOSPITAL \_\_\_\_\_ DATE \_\_\_\_\_ TO \_\_\_\_\_ 19\_\_\_\_\_

Number of syringes processed during survey week \_\_\_\_\_

Number of needles processed during survey week \_\_\_\_\_

Number of injections during survey week \_\_\_\_\_

Number of unused syringes weekly \_\_\_\_\_

Percentage of processed syringes not used  
(Divide number of syringes processed into  
number of unused syringes) \_\_\_\_\_Comments: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_



## SYRINGE COST SURVEY

CENTRAL SUPPLY PROCESSING

HOSPITAL \_\_\_\_\_

SUPERVISOR \_\_\_\_\_

DATE \_\_\_\_\_

TO \_\_\_\_\_

19\_\_\_\_\_

2 cc. syringes  
 5 cc. syringes  
 10 cc. syringes  
 20 cc. syringes  
 30 cc. syringes  
 50 cc. syringes  
 Tuberculin syringes  
 Insulin syringes  
 1 cc. syringes

|  | M | T | W | T | F | S | S | All Sizes |
|--|---|---|---|---|---|---|---|-----------|
|--|---|---|---|---|---|---|---|-----------|

Total syringes

Needles \_\_\_\_\_ gauge \_\_\_\_\_  
 Needles \_\_\_\_\_ gauge \_\_\_\_\_

Total Needles \_\_\_\_\_

Average Syringes Processed Daily

Average Needles Processed Daily

COMMENTS: \_\_\_\_\_



## SYRINGE COST SURVEY

## CENTRAL SUPPLY TIME STUDY

## HOSPITAL

SUPERVISOR DATE TO 19

**SHIFT** \_\_\_\_\_

**NOTE:** Each day, record the number of hours or fraction thereof each person spends on needles and syringes or any work related to the reprocessing. Start recording when the employee is assigned to syringes and needles and stop when another project is assigned. Include supervisory time for teaching and supervising. Use one form per shift if necessary.

\*Supervisor, R.N., Aide, etc.



## SYRINGE COST SURVEY

FRINGE LABOR BENEFITS

HOSPITAL \_\_\_\_\_

FINANCE OFFICER \_\_\_\_\_

DATE \_\_\_\_\_

Write in column (2) those fringe labor costs which apply to the hospital, plus any others which may not be listed.

|                                 | (1)<br>Percentage of<br>Annual Pay | (2)<br>Per Cent<br>Applicable |
|---------------------------------|------------------------------------|-------------------------------|
| Social Security                 | 3.0                                | _____                         |
| Unemployment Insurance          | 1.0                                | _____                         |
| Sick Leave                      | 2.9                                | _____                         |
| Workmen's Compensation          | 1.0                                | _____                         |
| Coffee Breaks (20 minutes/day)  | 4.6                                | _____                         |
| Two Weeks Vacation              | 4.1                                | _____                         |
| Six Paid Holidays               | 2.5                                | _____                         |
| Meals (1 per day 75 cents)      | 6.4                                | _____                         |
| Pension Plan                    | 5.9                                | _____                         |
| Free or Reduced Hospitalization | 2.4                                | _____                         |
| TOTAL                           | 33.8                               | _____                         |

COMMENTS: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_



## SYRINGE COST SURVEY

## CENTRAL SUPPLY LABOR COSTS STUDY

HOSPITAL \_\_\_\_\_

SUPERVISOR \_\_\_\_\_ DATE \_\_\_\_\_

LABOR COSTS:

| (1)<br>Employee Classification | (2)<br>Hourly Wage | (3)<br>Fringe Benefits* | (4)<br>Total Hourly Labor Cost |
|--------------------------------|--------------------|-------------------------|--------------------------------|
| _____                          | \$ _____           | \$ _____                | \$ _____                       |
| _____                          | \$ _____           | \$ _____                | \$ _____                       |
| _____                          | \$ _____           | \$ _____                | \$ _____                       |
| _____                          | \$ _____           | \$ _____                | \$ _____                       |
| _____                          | \$ _____           | \$ _____                | \$ _____                       |

\*Apply percentage as determined on Form E, column number (2).

ACTUAL YEARLY LABOR COSTS -- Re-usable syringe:

| Employee Classification | No. Hours<br>Weekly<br>Form No. 4 | No. Hours<br>Yearly | Total<br>Hourly Wage<br>Column (4) Above | Yearly Cost    |
|-------------------------|-----------------------------------|---------------------|--|----------------|
| _____                   | _____ x 52 = _____                | _____ x \$ _____    | _____                                    | _____          |
| _____                   | _____ x 52 = _____                | _____ x \$ _____    | _____                                    | _____          |
| _____                   | _____ x 52 = _____                | _____ x \$ _____    | _____                                    | _____          |
| _____                   | _____ x 52 = _____                | _____ x \$ _____    | _____                                    | _____          |
| _____                   | _____ x 52 = _____                | _____ x \$ _____    | _____                                    | _____          |
| _____                   | _____ x 52 = _____                | _____ x \$ _____    | _____                                    | _____          |
| _____                   | _____ x 52 = _____                | _____ x \$ _____    | _____                                    | _____          |
|                         |                                   |                     |  | TOTAL \$ _____ |



## SYRINGE COST SURVEY

SUMMARY OF INJECTION COUNT

HOSPITAL \_\_\_\_\_

SUPERVISOR \_\_\_\_\_

DATE \_\_\_\_\_ TO \_\_\_\_\_ 19 \_\_\_\_\_

Figures in column (2) are the totals of all Forms G2 collected at the nursing stations, or the actual number of disposable syringes used during the survey.

Actual injection totals during the week of the survey are converted to a yearly average by prorating to the average yearly census.

Average Yearly Census: \_\_\_\_\_

Census during Survey Week: \_\_\_\_\_

Adjustment Factor (per cent): \_\_\_\_\_

| (1)<br>Syringe Size | (2)<br>Number<br>Injections* | (3)<br>Census<br>Adjustment (%) | (4)<br>Average<br>Weekly<br>Injections | (5)<br>Average<br>Yearly<br>Injections |
|---------------------|------------------------------|---------------------------------|--|--|
| _____               | _____ x _____                | = _____                         | _____ x 52 = _____                     | _____                                  |
| _____               | _____ x _____                | = _____                         | _____ x 52 = _____                     | _____                                  |
| _____               | _____ x _____                | = _____                         | _____ x 52 = _____                     | _____                                  |
| _____               | _____ x _____                | = _____                         | _____ x 52 = _____                     | _____                                  |
| _____               | _____ x _____                | = _____                         | _____ x 52 = _____                     | _____                                  |
| TOTAL**             | _____                        | _____                           | _____                                  | _____                                  |

\*Total of all Forms G2, or the actual number of disposable syringes used during the survey.

\*\*Only total sizes which will be substituted by disposable syringes.



## SYRINGE COST SURVEY

DAILY INJECTION RECORD SHEET

HOSPITAL \_\_\_\_\_ WARD \_\_\_\_\_ SHIFT \_\_\_\_\_

SUPERVISOR \_\_\_\_\_ NO. OF BEDS \_\_\_\_\_ DATE \_\_\_\_\_

CENSUS \_\_\_\_\_

NOTE: Count only actual injections given with a glass syringe, not the number of syringes delivered or dirtied. Record this information in the "Number of Injections" column.

Record those syringes which do not result in an effective injection in the appropriate column under the "Rejects" heading.

| Syringe<br>Size | Number of Injections<br>Given | Rejects |              |        |       |
|-----------------|-------------------------------|---------|--------------|--------|-------|
|                 |                               | Stuck   | Contaminated | Broken | Other |
| 2 cc.           |                               |         |              |        |       |
| 5 cc.           |                               |         |              |        |       |
| 10 cc.          |                               |         |              |        |       |
| 20 cc.          |                               |         |              |        |       |
| 30 cc.          |                               |         |              |        |       |
| 50 cc.          |                               |         |              |        |       |
| Insulin         |                               |         |              |        |       |
| Tuber-<br>culin |                               |         |              |        |       |



## SYRINGE COST SURVEY

## MEDICATION LOSS

Percentage of total beds interviewed %

Hospital cost per dosage of medication  
most often lost

Average cost per dosage \$

Estimated number of dosages lost in hospital per week

**Estimated cost of medication loss per week**

Estimated yearly cost \$



## SYRINGE COST SURVEY

MEDICATION LOSS

(Station Questionnaire)

HOSPITAL \_\_\_\_\_

STATION \_\_\_\_\_ BEDS \_\_\_\_\_ SHIFT \_\_\_\_\_

We are currently performing a Cost Study throughout the hospital of our present method of giving injections, to determine whether it will be economically feasible for us to use disposable syringes and needles.

We believe that some medications are being lost when filled syringes "freeze," "stick," or are unusable because of worn syringe plungers or barrels. Of course, there may also be other reasons such as "leakage."

Would you please estimate the number of dosages of medication that are drawn into syringes and then not used on your shift each week:

Maximum number of dosages lost per week \_\_\_\_\_

Minimum number of dosages lost per week \_\_\_\_\_

Average number of dosages lost per week \_\_\_\_\_

Also list the drugs that are most often lost:

1. \_\_\_\_\_

2. \_\_\_\_\_



## SYRINGE COST SURVEY

## DISPOSABLE SYRINGE PURCHASE COSTS

# HOSPITAL

**SUPERVISOR** \_\_\_\_\_ **DATE** \_\_\_\_\_

DATE

**TOTAL** \_\_\_\_\_ \$ \_\_\_\_\_

#### **OTHER PURCHASE COSTS:**

| <u>Item</u> | <u>Cost</u> | <u>Yearly Cost</u> |
|-------------|-------------|--------------------|
|             |             |                    |
| x \$        | = \$        |                    |
|             |             |                    |
| x \$        | = \$        |                    |
|             |             |                    |
| x \$        | = \$        |                    |
|             |             |                    |
| x \$        | = \$        |                    |

**TOTAL** 



## SYRINGE COST SURVEY

SUMMARY

HOSPITAL \_\_\_\_\_

## TOTAL COST -- RE-USABLE SYSTEM

|                            |          |
|----------------------------|----------|
| Supplies                   | \$ _____ |
| Central Supply Labor Costs | _____    |
| Medication Loss*           | _____    |
|                            | \$ _____ |
|                            | _____    |

\*Estimated dollar value of medication loss per year (total of Form No. H1)

-----

## TOTAL COST -- DISPOSABLE SYRINGE SYSTEM

|          |          |
|----------|----------|
| Supplies | \$ _____ |
|          | _____    |
|          | _____    |
| TOTAL    | \$ _____ |
|          | -----    |

## COST DIFFERENTIAL

|                           |          |
|---------------------------|----------|
| Re-usable System          | \$ _____ |
| Disposable Syringe System | _____    |
| Net Difference            | \$ _____ |







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